Making successful virtual clusters

Jay Bal* , Shaan Lashari, S. Mohammad Nabavieh.

International Digital Lab, University of Warwick, Coventry, CV4 7AL, UK.

Improving competitiveness through the support of regional clusters is a common ingredient of industrial policy in many countries. Can we get the same benefits through virtual clusters? This was a core question in this research. To answer this question a literature review on the benefits of geographical clusters as well as benefits and challenges of virtual clusters was conducted. The authors operate an industrial virtual cluster in a UK using a web based portal and comment on its operation and limitations. A further question asks whether it can work to create a single cluster across national boundaries. A questionnaire was prepared and distributed to 31 firms in Pakistan to assess the barriers they face working with the UK cluster. Through analysis of the data from the questionnaire, a set of recommendations to improve business communications in virtual clusters is suggested.

Keywords: Virtual Clusters (VCs); Virtual Breading Environments (VBEs); Geographical Clusters (GCs); Trust in VCs;

1. Introduction

This study attempts to assimilate the success factors of geographical clusters into virtual clusters. By doing so companies which operate in virtual clusters could enjoy the same cooperation benefits that companies in geographical clusters are currently enjoying. The authors have created and run a virtual cluster "The West Midlands Collaborative Commerce marketplace (WMCCM)" with detailed competence profiles of 400+ engineering companies located in the West Midlands, UK. Though this

* Corresponding author. Email: Jay.Bal@warwick.ac.uk

virtually operated, geographically based cluster has been successful in boosting the economic performance of its member companies, (over US$5Bn worth of contracts were won by members in 2011-12) attempts to link them with other regions to break the bounds of geography have not yet succeeded, though individual examples of success have occurred. This paper identifies and analyses the attitudes of engineering businesses in Pakistan to working with this virtual cluster. The remainder of this paper is organised as follows: section two reviews geographical clusters and their benefits for companies. In section three, the benefits and challenges of virtual clusters are presented. Trust is identified as one of the most important factors for virtual clusters and various aspects of trust for virtual clusters are presented in section four. The research methodology applied in this research together with the result of data analysis are presented in section five, with a set of recommendations for improving communications for virtual clusters discussed in section six.

2. Geographical Clusters

A Geographical Cluster (GC) is a system in which firms acting independently to maximize their own profits come together in a limited geographical space and are governed by a set of rules and norms. Each geographical cluster has a culture and a set of institutions of its own, which interact with the agents of the cluster and help the cluster grow and adapt to changes. All the firms in the cluster specialize in something and production is flexible among firms (Bagella & Becchetti, 2000). Porter (1998) has further narrowed the concept of geographical clusters to one of a "particular field or industry with its supporting functions for smooth running of the cluster." There are various examples of GCs around the world. In Taiwan, there is a GC of the semiconductor industry in Hsinchu city. There are various firms located inside this cluster, which produce different components and products related to the semiconductor manufacture industry (Wang, 2002). The author recently visited a scientific instruments cluster in Ambala, India. Another example is an automotive cluster, which is located in the West Midlands in the United Kingdom (UK). In this cluster, original equipment manufacturers like Land Rover have their central manufacturing and assembly plant in this area.

Smaller firms making car components have also clustered here to support the Original Equipment Manufacturers (OEM).

2.1. Geographical Clusters' Benefits

Porter (1998) describes firms associated with geographical clusters as having better productivity, and that they often perform better than firms that are outside the cluster perform. Porter's classifications of these benefits (with comments from other authors) are:

2.1.1. *Better Access to Employees and Suppliers*

A geographical cluster often already has a good pool of skilled labour as skilled labour is attracted to the region by the opportunities available. This makes the hiring process for a firm easier, and usually the labour is more productive than in other non-clustered areas. Fabiana et al (2000) points out that average size of firms in a cluster is smaller than those outside by about three employees. This suggests that firms in a cluster are more productive.

2.1.2. *Trust among actors*

Trust is a key factor in the formation of clusters and a causal factor for the collaboration and collective actions of firms within a cluster (Dupuy & Torre, 2006). Trust is built over time among firms within a cluster due to repeated actions, which generate a reputation. Thus, informed decisions can be taken when working with them based on their reputation. There is often a high level of trust among people working in the same cluster, it is easier to make agreements, and people are more willing to share their knowledge out of a sense of community (Porter, 1998).

2.1.3. *Innovation advantages*

Firms inside a GC have innovation advantages in terms of both better speed of innovation and lesser expenditure on R&D activities as well as a market for newly innovated products. Bagella and Becchetti (2000) empirically found that firms that are belong to clusters in Italy spent less on R&D than firms outside the clusters. They argue that this is due to easy imitation of new technology and products inside a cluster due to better knowledge flows. Porter (1998) argues that firms inside a cluster innovate according to the sophisticated demand in the region and thus innovation is driven by customer requirements. This puts the firms at a lesser risk in terms of innovation and new product development because they have an informed idea of customers' requirements and even sometimes, they have a customer before the new or improved product is developed.

2.1.4. *Access to specialized information and knowledge*

Firms inside a cluster have better access to knowledge and information due to collaboration and cooperation among them. Firms have relationships with suppliers and other groups operating at a different part of the production cycle of an industry and are able to exchange knowledge with each other about new technologies and better ways of carrying out business operations (Porter, 2000). Henry and Pinch (2006) have argued that firms in a cluster build up a pool of knowledge through 'learning by doing'. This knowledge flows within the cluster boundaries as firms imitate and help each other by sharing experiences. Common culture in the cluster in terms of behaviour in business transactions helps firms in clusters enter into agreements easily and transaction costs are reduced.

2.1.5. *Complementarities*

A very concrete example of complementing businesses helping each other has been described by Desrochers et al (2008) in which the town of Kalundborg in Denmark has six plants that engage in water, energy and solid waste exchange programs. In actuality, the complementarities might not be so direct but this does emphasize the importance of support businesses in a cluster. Firms can become part of the supply chains of Original Equipment Manufacturers (OEMs) which prefer to buy their supplies in local area while at the same time keep their autonomy and freedom. In a GC setting when

there are directly (e.g. Car Assembly and Tyre Manufacturers) and indirectly (e.g. transport, telecommunication and finance) complementing companies, the clusters are much more sustainable and more stable in an unstable environment (Desrochers et al, 2008).

3. Virtual Clusters or Virtual Breading Environments (VBE)

The capability provided by modern communications technology may give us the ability to gain the benefits of geographical clusters without the constraint of local location.

3.1. Definition of Virtual Cluster

There is no exact definition for the term 'virtual clusters' in the literature; however, the definition of Virtual Breading Environments (VBEs) is very close to what it is referred to as virtual cluster in this paper. In addition, a number of authors including Galeano & Molina (2005) have used these two terms interchangeably. Camarinha-Matos & Afsarmanesh (2005) define VBEs as "an association or pool of organizations and their related supporting institutions that have both the potential and will to cooperate with each other through the establishment of a "base" long-term cooperation agreement and interoperable infrastructure." One of the main goals of a virtual cluster is to assimilate all of the benefits of a geographical cluster; this includes the formation of business collaborations. However, apart from this purpose, a virtual cluster should be able to satisfy the needs of its members as a GC does in terms of easy access to suppliers, employees, and customers. Innovation should be achieved through alliances between firms and knowledge flow within the cluster. The following are some examples of VBEs that are currently operational.

3.1.1. *ITESM (IECOS)*

IECOS (Integrated Engineering and Construction Systems) was developed in 2001 as a part of the Mexican initiative called integrated manufacturing systems centre (ITESM in Spanish). Mejia & Molina (2002) have discussed two cases pertaining to the IECOS in which an OEM was looking for a new supplier of parts. It was able to do so by utilising this online forum or 'virtual enterprise'. This is how IECOS started. At the moment, IECOS offers customized solutions to its customers who are

looking for engineering capabilities of firms to do a project. IECOS also supplies engineering services, mechanical and construction related products.

3.1.2. Virtuelle Fabrik

The most cited virtual enterprise in the geographical cluster based in Switzerland and the most well researched one is Virtuelle Fabrik. This project started in 1997 and is apparently now running without external funding. It offers engineering solutions as well as components in metalworking and plastic injection moulding among other things (Pluss & Huber, 2005). The way the orders are processed is that the order is posted on the intranet of the network and all the companies can see the order. Then the most suitable company in terms of core competency and most value added in fulfilling the order will take the responsibility to find the other necessary partners. A virtual organization is then created. Quality, cost and time objectives are decided upon and eventually the order is delivered (Pluss & Huber 2005).

3.2. Virtual Clusters' Benefits

Afsarmanesh & Camarinha-Matos (2005) have identified a number of advantages for VBEs. These benefits are summaries in table 1.

Table 1 - Virtual Clusters' Benefits (Source: Afsarmanesh & Camarinha-Matos, 2005).

Virtual Clusters' Benefits	Description
Quick VO formation	By reducing the complexity and the required effort for VO creation, virtual clusters provide a cost-effective, agile and flexible environment for VO reconfiguration.
Efficient IC technology infrastructure	VBE members could make a use of effective IC technology infrastructures, which is used as a foundation for cooperation and partnership.
VBEs' pool of resources	VBE members could make use of common distributable knowledge such as characterization of processes and products, lessons learned from other organisations and software tools.

VBEs' motivational methods	VBEs have guidelines and mechanisms to facilitate formation and development of VOs.
VBEs' sensible management	VBEs have realistic management to ensure that all of the required competencies and resources are available inside the VBE.
VBEs' supportive facilities	VBE members could utilize the VBEs' insurance and life maintenance facilities via harmonizing institutions for insurance, branding, training purposes.
VBEs' trust-building mechanism	VBEs have various methods of trust building methods such as keeping record of members' performance history and guidelines for developing trust among VBE members.
VBEs' collaboration mechanism	VBEs have wide range of rules and principles such as partnership ethics and IPR protection to facilitate cooperation and partnership between members.
VBE members' profiling feature	The availability of members' profile in VBEs which consists of various information such as members' products and services, competencies, and resources, increasing the chances of VO creation for VBE members, even from remote geographic regions.
Improved risk-taking capability of VBE members	Since in VBEs the required time and effort for creation of VOs are reduced and an extensive range of competencies and indicators of other members past performance and level of trustworthiness are available for members, VO initiators' capability for risk-taking is highly improved.

3.3 Virtual Clusters' Challenges

Various authors have talked about challenges of virtual clusters; in this section, some of these challenges will be presented. Rosas & Camarinha-Matos (2008) mention issues such as companies' trust level prediction, collecting competencies, withdrawal of previous performance data and members' readiness evaluation, and improvement, as elements that need to be considered in VBEs. In addition, Afsarmanesh & Camarinha-Matos (2005) have mentioned the following elements as the main challenges that VBE frameworks are confronting.

3.3.1. Competencies Management:

Afsarmanesh & Camarinha-Matos (2005) define competencies as a combination of abilities and facilities. Management of the competencies is essential for a VBE management system. The Competency Management System (CMS) of a VBE should include a list of competencies and a

number of applications to manage it. Table two describes the features that competencies catalogue of a CMS should included based on Afsarmanesh & Camarinha-Matos (2005) study.

Table 2 - VBE Competencies' Catalogue Features (Source: Afsarmanesh & Camarinha-Matos, 2005).

Competencies Catalogue Features	Description
Map of competencies / skills	Companies' competencies should be clearly defined and structured. In addition, an appropriate navigational interface should support this feature.
Associated competencies / skills	Similar skills in a VBE need to be identified so that they could be replaced if necessary.
Various Levels of Search	Different levels of competencies including the more general levels (e.g. welding), and some more specific levels (e.g. spot welding) should be specified.
Competencies Inter-relationship	The association between different skills and competencies must be clarified.
Collection of competencies' properties	To distinguish a competency, different characteristics of a given competency need to be clarified.
Essential catalogue operations	Fundamental operations of a catalogue such as searches, add, edit and remove functions need to be included.
Main Core and a number of non-core competencies	For each VBE member, the core and the non-core competencies need to be distinguished.
Total VBE competency valuation	The overall competency of the VBE from external viewpoint need to be considered.
Operational viewpoint	The methods for collecting competencies in a VBE (e.g. either automatic or manual) and the method for updating them should be determined.
Level of competencies	For any given competency of a VBE, the level of mastery in that competency needs to be realized. This could determine that a specific VBE is expert in a competency to the level of setting strategic developments.

Management of the cluster competencies is a critical task. Out of date or incorrect competence information can destroy trust in the cluster. The process of collecting and managing competencies is one of the most expensive functions in managing a virtual cluster. A number of attempts have been made to automate or simplify it. For example on WMCCM the authors have tried a feedback rating system (similar but more complex than eBay),while others have tried automated updating by analysing company information. Feedback with WMCCM suggests an independent competence assurer role is crucial. Afsarmanesh & Camarinha-Matos (2005) has specified a number of applications for managing a competencies catalogue, which are presented in table three.

Table 3 - VBEs' Required Functionalities (Source: Afsarmanesh & Camarinha-Matos, 2005).

VBEs' Required Functionalities	Description
Competencies assessment application	One of the requirements of a VBE is a functionality to determine the robustness or sustainability of the VBEs' competencies. It should also analyse the skills gap in the VBE and investigate the result of one member leaving the VBE.
Marketing application	A VBE needs to be able to verify strength and weaknesses of the VBE's competencies and identification of the appropriate methods to find opportunities for selling to the outside world.
Acquiring harmonizing skills	A VBE should be able to attain complementary internal and external skills that could support functionalities of that VBE.
Official approval of competencies	A VBE needs to be able to rate the quality of the members' performance and their past performances.
The concept of combined competency	A VBE needs to be able to determine which of its competencies is a result of two or more partners' cooperation, and cannot be obtained by one of the partners on its own.

3.3.2 Value Systems:

Afsarmanesh & Camarinha-Matos (2005) argues that in any VBE framework for any products or services a "value creating system" needs to be created through formation of VOs. Value system of a VBE needs to provide the following:

- A directive method: a method to understand members' behaviour, to create performance indicators and to ensure social consistency
- A communication method: a method to guarantee smooth effectiveness among exchanged objects

From a managerial viewpoint, it is crucial to find out which values in the list of values should be included in a specific VBEs' value system. Another related research challenge is the details of performance indicators - for VBE as a whole, for VOs and for VBE members.

3.3.3 System of incentives:

Afsarmanesh & Camarinha-Matos (2005) argue that it is essential for a VBE to have a system of incentives to attract and retain members and partners. In business-related VBEs, the main

incentives for participants are business profits and having access to knowledge. The following are a number of incentives for members of a business related VBE:

(i) A guarantee to be involved in certain number of VOs during a particular period.

(ii) Making use of a number of fundamental equipments, which are provided in the VBE pool of assets

(iii) Participation in conferences, courses, and tutorials to improve companies' productivity

(iv) An early assessment of the member and a promise to provide productive advice and recommendations to enhance companies' position in an agreed period

3.3.4 Trust management:

Afsarmanesh & Camarinha-Matos (2005) point out the importance of trust as one of the most important elements, which needs to be included in a VBE to create an effective and productive cooperation and transaction. Having a trustworthy environment in a VBE could assist information sharing and open communication, which could result in a faster contract process. A trustworthy environment could also reduce management, transaction and acquisition costs, and could certainly influence knowledge creation. Nevertheless, trust building is not a straightforward task. Trust is a result of past and present performance of an organisation in a VBE. Therefore, trust building usually takes time and needs to be supported by the VBE (Afsarmanesh & Camarinha-Matos, 2005).

4 Management of Trust in VBEs

4.1 Importance of Competence Profiling for trust building

Camarinha-Matos et al (2009) mention the importance of firms' competency profile in a VBE. A profile is composed by determining characteristics such as location, name, and capabilities. This is essential for a VBE since it could assist companies to identity the required information about their potential partners.

Armoutis et.al (2007) have also come up with a competence based framework for online collaboration in which companies or firms in a virtual cluster setting are listed according to their competencies. According to Armoutis et.al, (2007) competency is "the notion that captures the capabilities represented by the key tangible assets, embodied with the abilities of human beings and their key experience and knowledge. It can be interpreted as the company's ability to change and to adapt to different situations or market sectors that have the potential for better profitability."

Accordingly, it is essential that companies' competencies would be available to other firms and there would be a way to validate that information by an evaluation from an "expert" in the field to validate the information on competency. This information could then help companies to find the most suitable suppliers and customers for their products. This framework provides a good and logical starting point for virtual clusters. This is because the first thing that is needed is the presentation of information regarding the firms operations and processes that potential suppliers are looking to supply or potential customer is looking to buy from.

4.2 Trust building among Virtual Teams

Holton (2001) found in his research on virtual teams that telephonic conversations and virtual conferencing helped team members in communicating and clearing misunderstandings about the project. All team members in the research felt that they needed to meet face to face to develop more trust and a connection, which would most likely make it easier to work with their team members. The important thing to note about virtual teams is that all virtual teams felt that they need to meet in person and could have worked better if they knew whom they were working with. Therefore, although the required level of performance can be delivered in a virtual setting, physical meetings are also important. Many organizations believe that virtual teams are the way to the future and it is important to study ways to improve their performance (Townsend et al, 1998). Research on what people think about video conferencing has found that people rate video conferencing better than telephonic conversations and actual meeting in media richness (Kydd & Ferry, 1994). Kydd & Ferry (1994) found in their research that video conferencing was successful if the agenda of the meeting or the focal point was clear and everyone had prepared for the meeting. The literature suggests that video

conferencing seems to be a promising tool for people in geographically distant locations to communicate and collaborate if they wish to.

4.3 Trust in Long distance Business Relationships

Zheng et al (2002) and Moore et al (1999) measured trust by different prisoner dilemma games between participants and found out that trust is highest after a face-to-face meeting between the participants. Olson et al (2002) found that the richer the media of communication in virtual teams, the better the trust. Thus, video and audio conferencing was deduced to be better than online chat. They also saw an effect of "delayed trust" which was that after a few rounds participants who did not meet face-to-face, developed trust and their results in the prisoner's dilemma game improved. This shows that people can develop trust to the level of a face to face interaction through being in trust, or not to trust decision situation few time with a particular person. Therefore, if no opportunistic behaviour takes place at either end, then the parties will start trusting each other in the next interaction. Thus, the first and most crucial step towards developing trust in a virtual cluster is to make sure that somehow the firms themselves initiate the initial interaction.

5.0 **Research Methodology**

A questionnaire consisting of seven questions was distributed to thirty firms to do a statistically significant quantitative analysis. Because of the limitations of this research, it was not possible to find firms inside a cluster all of which have worked in a long distance setting or have had international customers or suppliers. Therefore, some firms, which answered the questionnaires, were firms that were located inside cities, which have agglomeration advantages. According to Press (2006), GCs are all areas where firms have agglomerated and there are agglomeration externalities like the existence of low transport cost and other co location advantages.

All of the firms who participated in this research have had or are still having a long distance relationship with either a supplier, customer or business partner. It can be argued that the advantages accruing to these firms are close to those of firms operating in a cluster strictly relating to a certain

industry. Thus, the results from these firms will be applicable when analyzing how to duplicate factors that are associated with the benefits accruing to firms in a GC.

5.1 Questionnaire Design

The complete questionnaire of this research can be found in appendix A. The first question in the questionnaire is about GCs and their benefits. The second question was set to see the potential reasons or advantages of working in a long distance setting. To further help in this analysis respondents were asked in question three as to which of the benefits of geographical clusters, are lacking in virtual clusters.

The fourth question was used to specifically verify the role of trust in business operation. The bias assumption is that trust as an important factor, this needed to be validated. From the fifth question onwards the inductive research starts. Question five looked at the benefits of trust to entrepreneurs working in an embedded setting, or close local proximity or belonging to the same culture.

The sixth question gauged the elements that help in developing trust among entrepreneurs working in a long distance setting. The last question examined propositions that the authors devised to check whether the entrepreneurs felt that the proposed online tools will help them develop trust in a long distance business setting or not.

5.2 Data Analysis

5.2.1 Question One

In the first question of the questionnaire, the participants were asked about the benefits of working with local companies located in the same region or close proximity.

Among the alternatives in this question, "***Trust and low transaction costs***" and "***Low transportation costs***" were identified to be the most important benefits, which are very important to firms located in an area with agglomeration advantages. Moreover, "***Access to other firms who are producing complementary products***" and "***Easy Access to customers***" were also found to be relatively important benefits to entrepreneurs. Finally, the last two factors including "***Access to***

specialized knowledge about new technologies" and "***Collaboration opportunities***" were found to be neither an important, nor an unimportant benefit to firms located in an area with agglomeration advantages.

5.2.2 Question Two

In the second question, the participants were asked about the benefits of working with companies which are not located in the same region, may be collaborating online or dealing with a long distance supplier or customer. The participated companies in this survey agree that "***Access to better technology of other firm or quality***" and "***Access to new market***" are two most important benefits, which can also lead to a long distance business relationship. Moreover, Firms are unresolved on whether "***Lower Unit Cost***" and "***Customized product***" are reasons/benefits for getting into a long distance business relationship.

5.2.3 *Question Three*

The third question, ask the participants to identify the benefits of geographical clusters identified in the first question, which are lacking when doing business in a long distance setting or an online-based collaboration.

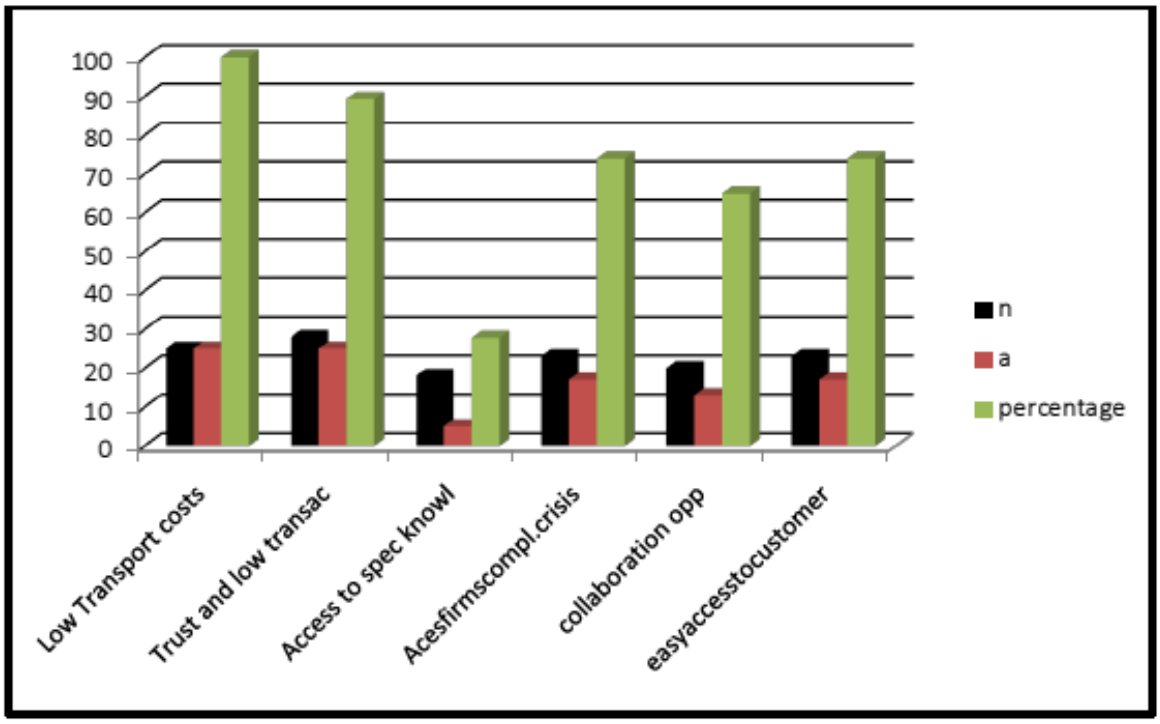

Figure 1 - Benefits lacking in cluster setting at a long distance

The black bar represents the number of respondents who rated the corresponding benefit neutral or positive. The red bar represents the number of people who thought that, that benefit was lacking, in their opinion, in long distance business dealing. The green bar represents the percentage of respondents (who answered question three) who think that the benefit is lacking or not present. As it can be seen from figure 1, "Low Transport costs" and "Trust and low transaction costs" are the two most important issues, as more than 85% of the respondents (green bar) of this question thought these are lacking in a long distance business relationship.

5.2.4 Questions Four & Five

In the fourth question, entrepreneurs were asked whether trust played any role in their business dealings and as expected the entire sample agreed. This was essential to avoid making the next question a leading question, which asks about the role of trust in business dealing. In the fifth question, the respondents were asked about the role of trust when dealing with suppliers, customers or/and business partners in close proximity where they belong to the same culture and meeting in person is easy. The majority of the participants agree that because of trust, decisions are made quicker and processes could become faster. However entrepreneurs neither agree nor disagree that "Help in

time of crisis from other firms" or "getting contracts due to trust developed because of working over the years", are as a result of trust in dealing with suppliers, customers or/and business partners in close proximity.

5.2.5 Question Six

The sixth question asked participants' opinion regarding the important factors in developing trust in another party in a long distance setting (where all communication is via the phone or the internet). It was seen that "Actual meeting" is considered very important factor in developing trust among potential business doers in a long distance setting. Moreover, "Information about processes and competencies of the other firm" and "Frequent easy and low cost communication" are two other relatively important factors in developing trust in a long distance setting. In addition, "Information about company's financial position and history" is not an important nor an unimportant factor in developing trust among potential business collaborators in a long distance setting.

5.2.6 Question Seven

Finally, in the seventh question, the participants were asked about online tools or factors that could help in developing trust and assist in getting into a long distance business relationship with a supplier, customer or business partner. It has identified that among the mentioned alternatives in this question, "Having pictures of people that you will be dealing with as business partner" will not have a very significant impact on developing trust. In addition, participants tend to agree that other factors including "A Rating System to rate previous performance of prospect business partner", "Having an in-depth knowledge about the potential business partner," and "finding the prospect business partner from a well-known or branded website" are beneficial tools or factors that could assist in getting into long distance business dealing. Moreover it was identified that "video conferencing" does not have a very significant effect on increasing trust but neither is it useless in developing trust.

6 Recommendations

Based on the result of the literature review and the empirical study in this research, the following general recommendations are suggested to VC administrators. Considering the following

recommendations could assist in increasing the level of trust among member-organisations of VCs. This is crucial to success.

6.1 Conferences and Meetings

Actual meetings are very important for forming trust among entrepreneurs. In an interview, Mr. Naseer, CEO of Infotechgroup, mentioned that "it is not only that you know your potential partner, but the knowledge that the other person has gone through some effort to take out the time to come and meet you" that builds trust. That this business deal is as important to him as it is to you and that helps you trust the person you are going to do business with. Therefore, to develop trust it is important that in a VC there are opportunities for the entrepreneurs and potential business partners to meet.

'Actual meeting' was a significantly factor when entrepreneurs were asked about trust forming when doing business. Some entrepreneurs were asked why they thought an actual meeting was important in t developing trust. They said that it was important because they needed to "connect" with the person they were doing business with, they needed to feel "comfortable", and after the meeting they felt more "confident" that the business deal or contract is going to go through as planned. These three words were used often in discussions with entrepreneurs. Though the virtual cluster needs to be dynamic and preferably companies should be able to collaborate and do business with only computer mediated communication, the fact is that there will always be a need for entrepreneurs to meet, needs to be kept in mind.

6.2 Communication

The questionnaire results prove that easy and frequent communication would significantly assist entrepreneurs in a long distance relationship. Therefore, it is important that each firm list a few phone numbers a few email addresses and upon receiving an email be efficient in communication (includes replying to texts, answering phone calls quickly VC administration should assist member firms and customers in communicating with each other.

Entrepreneurs felt that a video conferencing feature would neither help them trust other companies nor increase their likelihood of working with them. Four firms were asked afterwards through a phone call why they felt that this feature would not work. They answered that it would be hard to get representatives of CEOs from both firms on the phone at the same time especially if there is a time difference between the two regions of the firms. They felt uncomfortable with the technology and were not sure about how a video conference is supposed to proceed in terms of formalities and etiquette. This may be because they are located in Pakistan and video conferencing is not commonly used by SME owners. However, the suggestion is that ample communication avenues should be provided in the VC and communication should be made economical in terms of time and money so that entrepreneurs can easily reach and work with each other.

6.3 Annual Report

When two small companies want to enter into a business contract, an annual report or financial statement will help entrepreneurs to make better decisions about which companies to work with. This would increase the chances of companies working with each other and if this feature were available in a VC, it would encourage companies to trust and work with each other. However, members might not be willing to divulge their annual reports so easily, especially if they have not been performing well lately. Members should be convinced by the VC administration or informed that if they can present their annual reports it will increase their chances of getting business on the cluster. A potential problem is that start-up companies often do not have a track record or a published set of accounts. The authors experience with the WMCCM VC is that recommendation or approval by a reputable neutral third party (such as a University) can help to alleviate these issues.

6.4 Catalogue of products

A VC is largely about capability, less so about the actual products the firm currently supplies. However from the experience with WMCCM, the VC should provide access to the products of member firms. A catalogue of the firms products (and of the VC as a whole) will help develop trust about product specifications. It would probably be too risky to make a large order, just based on a

catalogue of products but it may encourage a sample from a supplier, which could be the starting point of a profitable business relationship. The danger is that sometimes companies define themselves too much by their products instead of their capability and unduly restrict the markets they address. They often do not appreciate that their current products are just one application of their capabilities, there may be many others. An example was a WMCCM company that made metal stampings for tractors. Their business focus and website was focussed on tractors, not their stamping capability, and hence when the tractors business fell into difficulty they did not easily see other opportunities in retail, automotive or railway markets.

6.5 Interactive Video of the Factory or Operations

Videos have the quality to capture a lot more information and deliver a more trustworthy impression of reality than just pictures or verbal descriptions. In the questionnaire, entrepreneurs agreed to the notion that an interactive video of the factory and/or operations would be a helpful factor in developing trust. By having a video of the factory, or even live webcams customers can place orders based on better information about the factory. The customers could more easily assess the technological level of the firm. These techniques can bring them a lot of additional business and would be a strong contributory success factor for a virtual cluster. In the West Midlands in the UK, a firm put up web cam feeds of its machinery and factory through its website and as a result attracted many customers from outside the UK. The fact that customers could potentially see their order being worked on increased trust substantially.

6.6 Rating system to develop trust

A customer/company rating system should be put in place in a VC for the facilitation of trust. Entrepreneurs in the survey agreed that it would help them develop trust and increase their likelihood of engaging into a long distance relationship. The trust system is self-reinforcing in the sense that companies know if they default on an agreement or make the other party dissatisfied it would adversely reflect on their ratings. This would in turn negatively affect their future prospects for business in the VC. Thus there is motivation to “do a good job” for their partner or customer.

The rating system should also be fair in the sense that a company will get a rating only after it has fulfilled a minimum number of contracts. The number of successful contracts or dealings completed by a company should be on the profile page of the company. Their rating on the virtual cluster will provide a sense of pride to business owners, just like in a geographical cluster where "word of mouth" reputation is important. Social networks and blogs can, and increasingly are, taking over this "word of mouth" communication role and need to be incorporated into a VC.

6.7 Professional Virtual Communities (PVC); A Supporting Tool To VCs

The PVCs' main role is to share knowledge and help find new business opportunities. PVCs are virtual representations of the local chamber of commerce or trade association. A question about their value was posted on a PVC, called the 'West Midland ICT Cluster' hosted on the LinkedIn networking site. An example response was:

> *"Absolutely!, Quite apart from the networking aspects that allowed us to engage with other like minded ICT companies, the help and advice provided has been invaluable. I would recommend this to any ICT business seeking to grow their business, but especially if they are looking for partners or other revenue opportunities via networking. The very first meeting I went to someone gave me a lead!"*

This example shows that the PVC, like a normal community, has the potential of bringing people who have same business interests closer and thus to emulate a GC by bringing all the businesses related to one industry into one virtual space for interaction. However, this does not mean that PVCs can completely emulate the knowledge diffusion advantages of a GC. Few people are very responsive on PVCs, the majority do not actively contribute. In PVCs people are not as embedded as when they are participating in a GC or where they belong to the same area, culture, and social circle. Thus sharing of knowledge may decrease due to this lack of "embeddedness", as argued by Wasko and Faraj (2005).

Secondly, the knowledge and information flows in a GC are usually due to easy access to other firm's technologies, staff turnover mong firms and close working relationships. A PVC may be

helpful in disseminating knowledge but to expect that it would be able to replicate the knowledge diffusion observed in a GC would be ambitious.

6.8 VC Administration

Thompson (2010) has discussed in his guide to collaborative networks that too much formality will not develop an atmosphere of trust. The first and foremost role of the VC administration is to make their VC into a brand name like Amazon.com or Ebay.com. In handling customer relationships in e-business, it is important to gain the trust of the customer (Davies, 2004).

The VC should spend on advertising and promoting itself via its current members and through publishing its own newsletter. These things will help to create a brand name of the VC. Members should pay a fee to use the cluster and these activities should be financed through that fee. If the VC administration can make itself into a popular, trusted brand identity, it would make entrepreneurs more comfortable in working with other companies on the VC. This could also drive companies to seek membership and to meet all the requirements of the VC. This would provide more funds for promotion, and a virtuous cycle established.

6.9 Competency

Presenting competency, that is, the processes and activities that they are good at it, is important in reaching new markets and developing new products. If a VC displays the competencies of all firms and a log of their business dealings then firms can locate each other and communicate to see if some cooperation could be developed. A suggestion for this, given by Thompson (2010), is that each of the firms in such a network would list their core competences on a board. Other business owners can then note and put their competence next to them with a comment on how they can produce added value through collaborating.

A demand matching system can also be helpful in a VC when firms are looking for collaborating on a business opportunity. Galeano and Molina (2005) have suggested a competence-

based system for business opportunities. They suggest that a customer will demand certain core competencies to fulfil an order. The VC administration will try to find a match of core competencies from its membership for the order and help organise a response to the opportunity.

Overall a VC could be seen as having a three level of competency system.

1. A competency listings for each member,
2. A presentation of the competency of the whole VC, and
3. The competency configured for a particular opportunity.

Figure 2 illustrates the competency map for the WMCCM cluster.

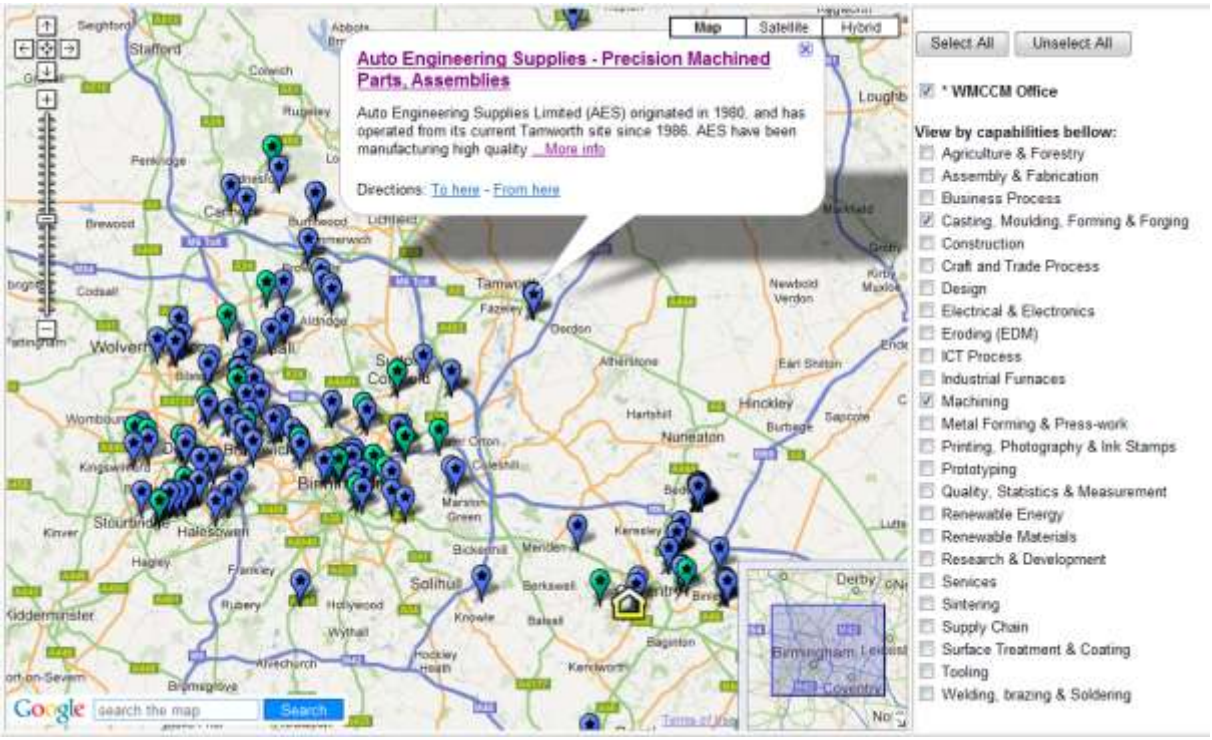

Figure 2: Competency Map for the WMCCM Virtual Cluster

6.10 Expected Return

In one of the interviews, a respondent stated that whether a business will get into a project with another entrepreneur depends on the expected return. He suggested that if the expected return is high enough, the level of trust required for them to get into long distance relationship will be significantly less. This is a high-risk high-return situation for entrepreneurs, where a lower level of

trust and thus higher risk is accepted in exchange for a high expected return. Therefore, if a VC can have some firms that are capable of delivering highly desirable technology or products to countries or regions where they are not available, entrepreneurs would be willing to do business with members of the VC, without significant trust development requirements.

7 Conclusion

The result of the questionnaires show that among all of the benefits of working in an region with agglomeration advantages, or inside a GC, trust and low transportation costs are the most important advantages. These are not inherent in VCs and thus mechanisms need to be devised.

It has been identified that one of the main elements in improving the level of trust among companies exploring a long distance relationship is having face-to-face meetings. In this research various factors important for creating trust in a VC have been discussed However, having an actual face to face meeting was still the main essential element. They can boost the level of confidence in business owners to begin and continue a relationship with potential business partners.

Another important conclusion is that business owners prefer to find their geographically distant business partners from well-known third party websites. Therefore, VC administrators need to build a brand identity for it to operate as a trusted third party.

Finally, it is necessary to remember that the expected return from a business transaction has a high influence on the level of risk-taking by business partners. Therefore, organisations are more likely to accept a higher level of risk if they realise that by joining a VC they could have access to competencies, which they need but are not available in their region.

References

Afsarmanesh, H and L. M. Camarinha-Matos. (2005) A Framework For Management Of Virtual Organization Breeding Environments, In Collaborative Networks and their Breeding Environments, pp. 35 – 48.

Armoutis, N., J. Bal, M. Swift. (2007). Collaborative Networks through Competence Profiling, ICE conference proceedings.

Bagella,M. and L. Becchetti. (2000), The Competitive advantage of Industrial Districts, Theoretical and Empirical Analysis. , Physica-Verlag, New York.

Camarinha-Matos, L. M., and H. Afsarmanesh. (2005), Collaborative Networks: a new scientific discipline. Journal of Intelligent Manufacturing, 16, pp 439-452 [online] Available at: http://datafedwiki.wustl.edu/images/e/e5/CollabNetworksNewDiscpl.pdf Accessed: 4th July 2010.

Camarinha-Matos,C. S.S, Msanjila, and H. Afsarmanesh. (2009). On management of 2nd generation Virtual Organization Breeding Environments, Annual reviews in control [Online] Available at: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V0H-4XJF3BH1&_user=585204&_coverDate=12/31/2009&_rdoc=1&_fmt=high&orig=search&_sort=d&_docanchor=&view=c&acct=C000029838&_version=1&_urlVersion=0&_userid=585204&md5=e381a4c4f5a7fa9e3d23d4bc563ddf23 Accessed: 25th June 2010.

Davies,B,P. (2004). Basingstoke, Hampshire ; New York : Palgrave Macmillan.

Desrochers,P. F.Sautet, and J.G. Hospers. (2008). In : Charlie Karlsson (eds). Hankbook of Research on Cluster Theory. Edward Elgar Publishing, Cheltenham, UK.

Dupuy,C. and A.Torre. (2006). In: Pitelis,C. Roger,S. and Wilson,R,J. (2006), Clusters and Globalization, The development of Urban and Regional Economies, Edward Elgar Publishing Limited, Cheltenham UK.

Fabiana,S. G. Pellegrini, E.Romagnano, and L.F. Sigorini. (2000) In: Bagella,M. and Becchetti,L. eds, The Competitive advantage of Industrial Districts, Theoretical and Empirical Analysis. , Physica-Verlag, New York, pp. 51-66.

Galeano,N and A. Molina. (2005). Core Competence Management in Virtual Industry Clusters [Online] Available at: http://www.nt.ntnu.no/users/skoge/prost/proceedings/ifac2005/Fullpapers/04793.pdf Accessed: 15th June, 2010.

Henry,N and S.Pinch. (2006). Knowledge and Clusters. In: Pitelis,C. Roger,S. and Wilson,R,J. 2006, Clusters and Globalization, The development of Urban and Regional Economies, Edward Elgar Publishing Limited, Cheltenham UK.

Holton, J. A. (2001). Building trust and collaboration in a virtual team. Team Performance Management, 7(3/4), pp.36-47.

Kydd,T,C. And L.D. Ferry. (1994). Case Study Managerial use of video conferencing. Information & Management 27 [Online] Available at: http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6VD045MGSR2J&_user=585204&_coverDate=12/31/1994&rdoc=1&_fmt=high&_orig=search&_sort=d&_docanchor=&view=c&_acct=C000029838&_version=1&_urlVersion=0&_userid=585204&md5=5193ebaf43b624c7a9e33686053ae2f4 Accessed::9th July, 2010.

Mejia R., A. Molina. (2002). Virtual EnterpriseBroker: processes, methods and tools, in Collaborative Business Ecosystems and Virtual Enterprises, L. Camarinha-Matos (Ed.), Kluwer Academic Publishers, pp. 81-90.

Moore,A,D., T.R. Kurtzberg, and L.L. Thompson. (1999). Long and Short Routes to Success in Electronically Mediated Negotiations: Group Affiliations and Good Vibrations. Organizational Behavior and Human Decision Processes, 77(1) [Online] Available at: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.8.260&rep=rep1&type=pdf Acccessed: 22nd July, 2010.

Olson,G. N. Bos, G. Gergle, J.Olson, and Z.Wright, (2002). Effects of Four Computer-Mediated Communications Channels on Trust Development. Chi [Online] Available at: http://portal.acm.org/citation.cfm?id=503376.503401 Accessed: 16th July, 2010.

Pluss, A. And C.Huber. (2005). Virtuellefabrik.ch –a source network1 for VE in Mechatronics [Online] Available at: www.springerlink.com/index/u76tm361413x1u26.pdf Accessed: 6th July, 2010.

Porter,E,M. (1998). Clusters and the new economics of competition [Online] Accessed: 16th June, 2010 Available at: http://www.wellbeingcluster.at/magazin/00/artikel/28775/doc/d/porterstudie.pdf?ok=j

Porter,E,M. (2000). Location, Competition, and Economic Development: Local Clusters in a Global Economy, Economic Development Quarterly [Online] Accessed: 24th June, 2010 Available at: http://edq.sagepub.com/cgi/content/abstract/14/1/15

Press,K. (2006). A Life Cycle for Clusters? The Dynamics of Agglomeration Change, and Adaption. Physica-Verlag, New York, pp. 7-41.

Rosas, J., & L.M. Camarinha-Matos. (2008). A collaboration readiness assessment approach. Innovation in Manufacturing Networks, pp.77–86.

Thompson, K. (2010). A Taxonomy of virtual business networks. [Online] Available at: http://www.younetfast.com/2010/07/taxonomy-of-virtual-business-networks.html Accessed: 4th August, 2010.

Townsend,M,A., M.S. Demarie, and R.A. Hendrickson. (1998). Virtual Teams: Technology and the Workplace of the Future The Academy of Management Executive (1993-2005), 12(3) [Online] Available at: http://www.jstor.org/stable/4165474 Accessed: 9th July, 2010.

Wang,K. (2002). High-Tech Industrial Clusters in the Asian Countries: The Case of the Electronics Industry in the Hsinchu-Taipei Region. In Curzio AQ and Fortis M (eds) Complexity and Industrial-Clusters Dynamics and Models in Theory and Practice. Physica, Heidelberg, New York, pp. 267-291.

Wasko, M and S.Faraj. 2005. Why should i share? Examining social capital and knowledge contribution in electronic networks of practice1 mis quarterly vol. 29 no. 1, pp. 35-57.

Zheng,J., E. Veinott, N. Bos, S.J. Olson, and M.G. Olson. (2002). Trust Without Touch: Jumpstarting long-distance trust with initial social activities. Chi Letters, 4(1) [Online] Available at: http://portal.acm.org/citation.cfm?id=503402.